"STUDY OF SURGICAL SITE INFECTION IN SURGICAL WARDS IN TVMCH"

Dissertation submitted to the

THE TAMIL NADU DR.MGR MEDICAL UNIVERSITY

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In partial fulfillment of the requirements

for the degree of

MASTER OF SURGERY IN

GENERAL SURGERY

DEPARTMENT OF GENERAL SURGERY

TIRUNELVELI MEDICAL COLLEGE

TIRUNELVELI-627011

TAMIL NADU DR.MGR MEDICAL UNIVERSITY
CHENNAI, TAMIL NADU

CERTIFICATE

This is to certify that the dissertation titled **"STUDY OF SURGICAL SITE INFECTION IN SURGICAL WARDS IN TVMCH"** is the original work done by **DR.T.KARTHIKEYAN**, post graduate in the department of GENERAL SURGERY, TIRUNELVELI MEDICAL COLLEGE, TIRUNELVELI-11 submitted to THE TAMIL NADU DR.MGR MEDICAL UNIVERSITY, Chennai – 32 towards the partial fulfillment of the requirements for the award of M.S degree in GENERAL SURGERY April 2014 examination.

DR.S.K.SREETHAR, M.S.,
UNIT CHIEF
Department Of General Surgery
Tirunelveli Medical College
Tirunelveli – 11

DR.SOUNDARARAJAN, M.S.,
PROFESSOR AND HOD
Department of General Surgery
Tirunelveli Medical College
Tirunelveli -11

THE DEAN
Tirunelveli Medical College
Tirunelveli - 11

TIRUNELVELI MEDICAL COLLEGE

TIRUNELVELI,

STATE OF TAMILNADU, INDIA

PIN CODE:627011

Tel: 91-462-2572733, 2572734 Fax: 91-462-2572944

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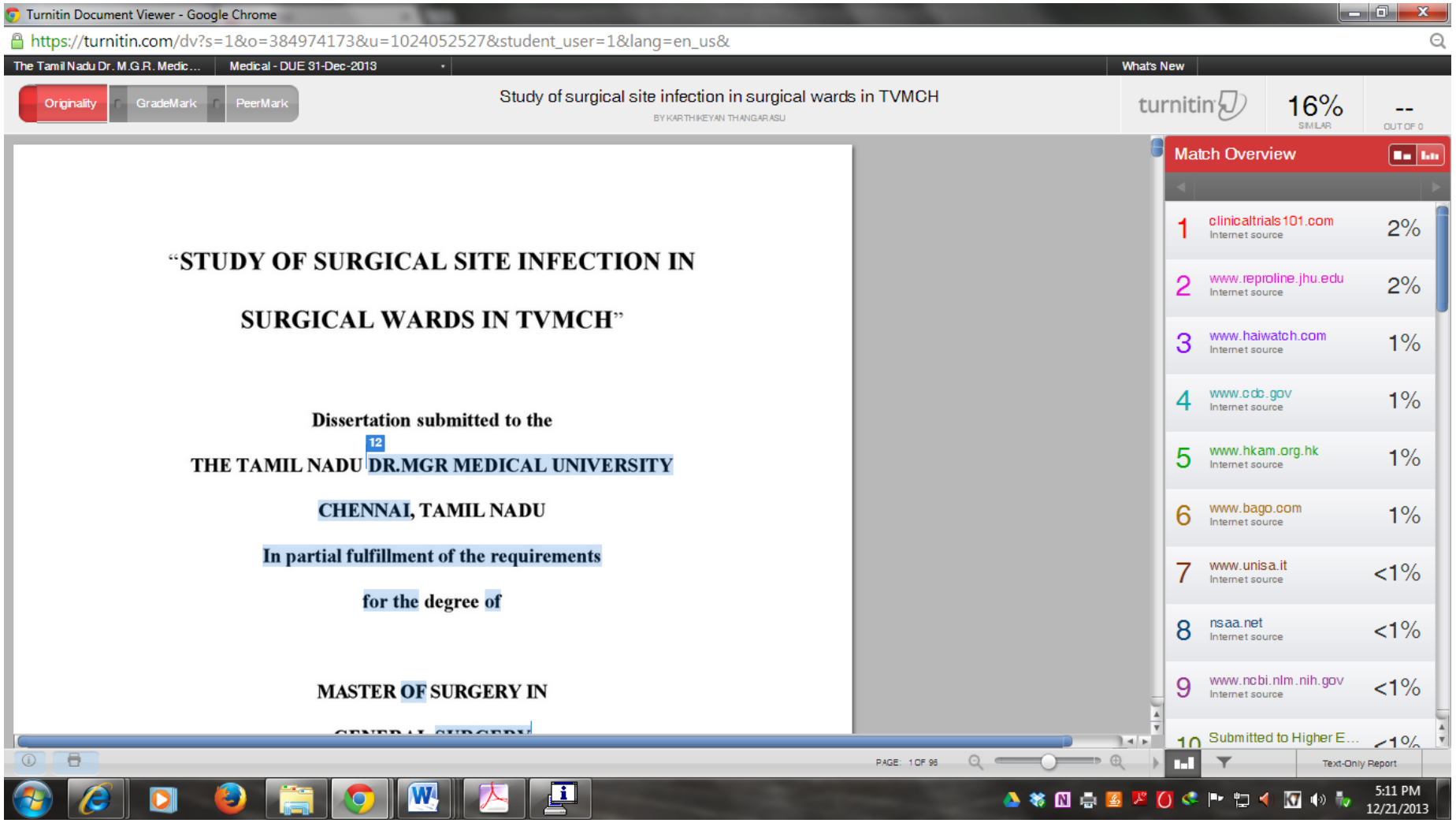
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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation/thesis entitled "**STUDY OF SURGICAL SITE INFECTION IN SURGICAL WARDS IN TVMCH"** is a bonafide and genuine research work carried out by me under the guidance of **Prof. Dr. S.K.Sreethar M.S,** Department of Surgery, Tirunelveli Medical College, Tirunelveli– 627011.

Date :

Place: Signature

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I bow my head to my living gods.... **MY PARENTS**, the reason I am here today, they have formed my vision in life.... this acknowledgement would be incomplete if I don't mention heart felt regards to them.

"There is no achievements is greater than respecting the parents"

CONTENTS

ABSTRACT

Title : Study of Surgical site infection in surgical wards in TVMCH

Author : T.Karthikeyan

Key words : Post operative wound infection, Post operative complication

Background : Patient whom underwent abdominal surgeries in both elective and emergencies in TVMCH was included in this prospective study. Which include clean contaminated, contaminated, dirty surgical wounds. Total no. of cases studied were 458 in which elective cases were 249 emergencies cases were 209. Case were study between 2012 – 2013. Patient was evaluated Post operatively during wound cleaning and dressing or if wound dressing is soaked with discharge, until patient get discharged from ward and also in OPD after discharged.

Results : In our study 33 cases were infected out of which 8 cases (3.21%) are elective and 25 cases (11.9%) was emergency with incidence rate of 7.2%. Most common isolated organism was klebsiella (24.2%), E.coli (18.18%), Pseudomonas (6.06%), Staphylococcus (6.06%), Acinetobacter (3.03%). Most commonly the organisms was sensitivity to ciprofloxacin, amikacin, cefoperazone sulbactum, doxycycline, ampicillin, cefotaxime in decreasing order.

In our study the most common complication following surgical site infection was wound gapping, burst abdomen, incisional hernia, entro cutaneous fistula, death due to sepsis.

Conclusion : Surgical site infection was most commonly caused by gram negative organisms more in emergencies surgery. In dirty, contaminated, clean contaminated surgical wounds in descending order. Most common isolated in our study was klebsiella followed by E.coli.

INTRODUCTION

Surgical site infection (SSI) is the second most common complication following surgical intervention due to bacterial entry with high virulence, change in wound microenvironment and altered host defense mechanisms. SSI's is the second common hospital acquired infection. Surgical site infection plays an important burden on both the surgeon and the patients.

After development of Anaesthesia by Morton in 1846, many number of surgeries were done in the second half of nineteenth century. Because of high rate of infection and mortality surgical field did not progress well. After introducing antisepsis in Medicine practise by Ignaz Philipp Semmelweis followed by Joseph Lister, the decrease in wound infection rate and death rate in operative patients was seen. The contribution of Pasteur, Koch and Holmes in disease causing infection and establishment of operating room and environment by Halsted proved the antiseptic technique is the most efficient way in preventing the surgical site infection.

With development of antibiotic therapy in 20^{th} century, there is a reduction in surgical site infection and useful in prevention. Coming era , we hope chance of elimination of infection. At present surgeon faces most serious infection related to the combination of risk factors including duration of surgery, complicating surgery, surgery in old age, surgery done in patients with co morbid conditions, many procedure are done with implantation of foreign

material, rapid increase in organ transplantation which require usage of immunosuppressive drugs, and diagnostic tool was increased with treatment that cause increased bacterial exposure or suppression of host immune response .

At present a Surgeon has responsibility in dealing with surgical site infection , while dealing with infection , the knowledge about use of proper aseptic and antiseptic technique and appropriate use of antibiotic prophylaxis and treatment enough monitoring and supportive surgical as well as pharmacological and non pharmacological intervention.

AIM AND OBJECTIVES

1. Determining the incidence of surgical site infection in surgical wards on Abdominal surgeries in TVMCH
2. Identifying the common pathogen causing surgical site infection and sensitivity to antibiotics in TVMCH
3. Studying most commonest complication of surgical site infection and analyzing various preventive measures which reduce the incidence of surgical site infection
4. Reviewing literature on wound healing, wound infection and antibiotic prophylaxis in surgical site infection.
5. Studying the role of prophylactic antibiotic in reducing surgical site infection

REVIEW OF LITERATURE

Historical background

Roman named Marcus Varro explained that, Microbes was not until 100 B.C , certain minute invisible animals carried by air.

First surgeon in history is ancient man when he dared to cut off his limb, while it was entangled between the jaws of a wild forest animal.

Father of surgery, Ambrose pare (1500- 1590) – he tells to wounded patient "I dressed him and god cured him" [1]

Susuruta 6^{th} century BC – Father of Indian surgery mention made regarding cleanliness of surgeon and maintenance amply stressed in the ancient Hindu text "Susuruta Samhita". He wrote on the subject of wounds, its process of repair and management.

1683 – Antony Van Leeuwenhock – credit for having first person observed and reported about the micro organisms, bacteria.

Joseph Lister (1826 – 1912) - he was the Father of modern surgery, great contribution to surgery by antiseptic technique , that prevent the wound from infection, by demonstration [1]

1865 – Lister began applying pure carbolic acid into wounds.

1871 – Lister also began using carbolic acid spray to decrease contamination of the operating room atmosphere.

William stewart Halsted (1852 – 1922) introduced the rubber gloves for his nurse, caroline Hampton because the corrosive sublimate used to sterilize instrument mercuric chloride, which irritated her skin. [1]

Joseph Bloodgood –he began the regular use of gloves by the whole operative team.

1928 – Alexander Fleming – discovery of antibiotic drug, penicillin from penicillium notatum fungus.[1]

1940 – Howard Florey first clinically uses the penicillin to the patient.

Robert Koch (1843 -1910) – laid down the first definition of infective disease (Koch postulates)

1876 – Identify the bacteria anthrax bacillus

1882 – Identified mycobacterinm tuberculosis

1883 – Identified cholera bacillus

Louis Pasteur – clearly explained the relationship of microorganism to purulent discharge, pus formation – propounded the germ theory of diseases.

Von Bergmann, 1866 – who first introducing steam sterilization of surgical instrument.

1944 – Streptomycin was discovered followed by chloramphenical, tetracycline, aminoglycosides and beta lactum agent

John hunter – who explained the wound healing by first intention and second intention

Ignaz semmelweis (mid 19th century) – gynecologist, initiate hand washing with hypochlorite solution decreases puerperal infection rate dramatically.[2]

Ernst Bergmann had said "today we wash our hand before an operation" [3]

Sources of wound infection

Direct inoculation of micro organisms

- Patients residual micro organisms or skin contamination with micro organisms [8]
- Operative Surgeon's hands [8, 13]
- Contaminated instruments or contaminated gloves, apron and other dressing[10]
- Contaminated operation technique
- Drains, catheters, intravenous lines

Airborne contamination

- Skin and dress of assisting staff and patients

- Air flow in operating room or ward with improper ventilation [9]

Haematogenous spread

- Intravenous catherisation [12]
- Sepsis at other anatomical sites (remote infection) [12]

Risk factors to surgical site infection includes 3 main determinants.

1. Bacterial factors

    - Total number of Bacterial load, effectiveness of causing infection (virulence) and resistance of bacterial to the body
    - Duration of pre operative stay of patient in hospital
    - Remote site infection
    - Time duration for surgical intervention
    - Emergency surgery
    - Type of wound class
    - inappropriate antibiotic therapy for infection
    - improper Pre operative shaving or clipping

2. Local wound factors [13]

    - operative techniques
    - hematoma / seroma formation in wound
    - necrosis

- sutures materials
- drains
- foreign bodies in wound

3. Patient factors [13]

- age –extremes of age
- immunosuppression status [11]
- drugs, prolonged steroid use
- carcinoma
- obese
- diabetes mellitus
- under nutrition
- blood transfusion
- smoking cigarette
- low O2 tension
- Temperature
- Poor Glycemic control
- Vascular disorders

RISK CLASSIFIACTION AND IDENTIFICATION SSYTEM

Based on 3 categories -

1. Which estimate intrinsic degree of micro organisms contamination at the operative site.
2. It measures the duration of operation.
3. Host susceptibility markers.

VARIABLES THAT INFLUENCE SSI

SENIC RISK INDEX [13, 14, 15]

VARIABLES THAT INFLUENCE SSI	POINT
An abdominal surgery	1
Duration of Operation for more than 2 hours	1
Surgical wound site classified as contaminated or dirty / infected	1
Operative intervention on a patient with >3 discharge diagnosis	1
TOTAL INDEX	4

- SENIC risk index, which was replaced by the American society of anaesthisiologist (ASA) pre operative assessment score which was validated in a large study containing 44 hospitals from 1987 to 1990.

  The wound infection rate among ASA class 1 or class 2 - 1.9%

  The wound infection rate among ASA class 3to class 5 - 4.3%

AMERICAN SOCIETY OF ANAESTHIIOLOGISTS (ASA)

Pre operative assessment score

- Class I

  A patient in normal health.

- Class II

  A patient with mild systemic disease resulting in no limitations to their function.

- Class III

  Systemic disease of the patient is severe that limits activity but not to incapicititating.

- Class IV

  Systemic disease of the patient is severe, that is a constant threaten to survive

- Class V

  A diseased patient not likely to live 24 hrs.

THE NATIONAL NOSOCOMIAL INFECTION SURVEILLANCE AS BASIC SSI RISK INDEX [5]

NNIS SYSTEM	POINT
Operation contained as class 3 and class 4 surgical wound	1
The patient has an ASA preoperative score of 3,4, or 5	1
Duration exceeds 75th percentile of 'T' point.	1

'T' point defined as length of the time in hours that represents 75th percentile of procedures in NNIS survey.

The Tpoint for common surgical procedures

Operation	T point (hrs)
Coronary artery bypass graft	5
Bile duct , liver or pancreatic surgery	4
Craniotomy	4
Head and neck surgery	4
Colonic surgery	3
Joint prosthesis surgery	3

Vascular surgery	3
Abdominal or vaginal hysterectomy	2
Ventricular shunt	2
Hernio raphy	2
Appendectomy	1
Limb amputation	1
Cesarean section	1

PATHOPHYSIOLOGY SEQUENCE OF EEVNTS (IN SURGICAL WOUNDS)

All operative wounds are contaminated by micro organisms but only a minority actually presents clinical infections. In many of the patients infections doesn't occur because innate host defenses are quiet effective in the elimination of micro organisms at the surgical wound.

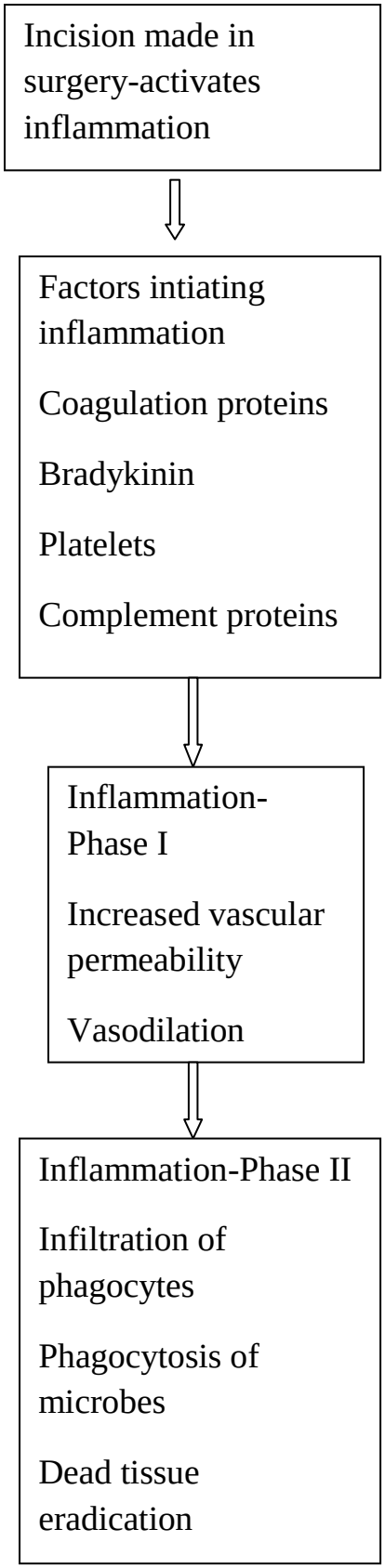
The inter play of four important determinants lead to either uneventful wound healing or surgical site infection.

1. Bacteria inoculation in wound
2. Effectiveness of bacteria to cause infection
3. Adjuvant effects of micro environment and
4. Innate and acquired immunity of host defenses mechanisms

- Initiation of inflammation introduced by cutting, incisions with knife, abrasions, burns wound.
- This process activates inflammatory process by protein coagulation, aggregation of platelet, initiate activity of mast cell, release of factors of complement and cytokines, bradykinin. These total effect result in beginning of phase 1 reaction
- Phase I - inflammation start with dilation of vessels, increased in flow, increased vascularity.
- Phase II of inflammation starts with polymorphic neutrophils infiltration and bacterial phagocytosis, removal of dead tissue with release of pro-inflammatory cytokines. In this circumstances neutrophils and monocyte reach the wound site before the inoculation of micro organisms, so the host is ready to act against the bacteria priorly. If contamination of bacteria is controlled monocytes initiate to regulate wound healing process using myofibrocytes and collagen materials.
- If micro organisms contamination is uncontrolled, proinflammatory cells release tumour necrosis factor-α to stimulate polymorphic for phagocytosis.
- At the same time it causes release of reactive O2and acid hydrolases from lysosomal vacuoles

- Which result in lipid peroxidation, release of cytokines, and initiate acute inflammatory response by creation of cavity containing purulent materials which contains dead tissue, polymorphic neutrophils, bacteria and proteinaceous rich fluid with all signs of inflammation – rubor, dolor, calor, tumour. It is typical suyrgical site infection (SSI).

Flow chart


Incision made in surgery-activates inflammation
Factors intiating inflammation
Coagulation proteins
Bradykinin
Platelets
Complement proteins
Inflammation-Phase I
Increased vascular permeability
Vasodilation
Inflammation-Phase II
Infiltration of phagocytes
Phagocytosis of microbes
Dead tissue eradication

CLASSIFICATION OF SURGICAL WOUNDS [9]

- Clean wounds

  Operation procedure which does not entered into normally colonized visceral organ.

- Clean – contaminated

  Operation which enters into colonized organ but enter elective controlled manner.

- Contaminated wounds

  More contamination with micro organisms is occured at the operative site with out of obvious microbial infection.

- Dirty wounds

  Surgical operative procedure done when active microbial infection is occurred

A. CLASSIFICATION OF WOUND INFECTION ACCORDING TO THE ETIOLOGY

   a. Primary infection where the wound is the primary site of infection.
   b. Secondary infection arises following a complication that is not directly related to the wound.

B. CLASSIFICATION OF WOUND INFECTION ACCORDING TO THE TIME

a. An early infection presents within 30 days of a surgical procedure.
b. An intermediate infection occurs 1-3 months after surgery.
c. Late infection occurs in >3 months after surgery.

C. CLASSIFICATION OF WOUND INFECTION ACCORDING TO THE SEVERITY

a. Minor wound infection if there is discharge without cellulitis or deep tissue destruction.
b. Major if discharge of pus is associated without tissue breakdown, partial or total dehiscence of the deep fascial layers of the wound, or if systemic illness is present.

The ASEPSIS wound score

Criterion	Points
Additional treatment	0
Antibiotics for wound infection	10
Pus drained under local anaesthesia	5
Wound necrotic materials removal under general anaesthesia	10
Serous discharge from the wound	daily 0–5
Erythema in and around the wound	daily 0–5
Pus discharge	daily 0–10
Separation of deeper tissues	daily 0–10
Bacterial isolate from the wound	10
Stay in hospital for long duration >14 days as result of wound infection	5

Wound grading system -Southampton system

Grade Appearance

0 -- Normal healing

I -- Normal healing with mild bruising or erythema

Ia --Some bruising

Ib --Considerable bruising

Ic --Mild erythema

II -- Erythema plus other signs of inflammation

IIa -- At one point

IIb -- Around sutures

IIc -- Along wound

IId -- Around wound

III -- Clear or haemoserous discharge

IIIa -- At one point only (not more than 2 cm)

IIIb -- Along wound (more than 2 cm)

IIIc -- Large volume

IIId -- Prolonged (more than 3 days)

Major complication

IV -- Pus

IVa -- At one point only (not more than2 cm)

IVb -- Along wound (more than 2 cm)

V - Deep or severe wound infection with or without tissue breakdown; haematoma requiring aspiration

Surgical Care Improvement Project (SCIP) Guidelines

SCIP INF 1	Antibiotic prophylaxis within 1 hour before incision
SCIP INF 2	Antibiotic prophylaxis selection for surgical patients
SCIP INF 3	Antibiotics prophylaxis discontinued within 24 hours after surgery (48 hours for cardiac patients)
SCIP INF 4	Cardiac surgery patients with controlled postoperative serum glucose at 6am
SCIP INF 5	Postoperative wound infection during hospitalization
SCIP INF 6	hair removal of surgical patients with appropriate material and time
SCIP INF 7	Normal temperature postoperatively in Colorectal surgery patients

NNIS Score and Risk for SSI

Risk Factors

Procedure time >75th percentile

Contaminated or dirty wound

ASA III, IV, V

Number of positive risk factors	Risk for SSI
0	1.5%
1	2.9%
2	6.8%
3	13%

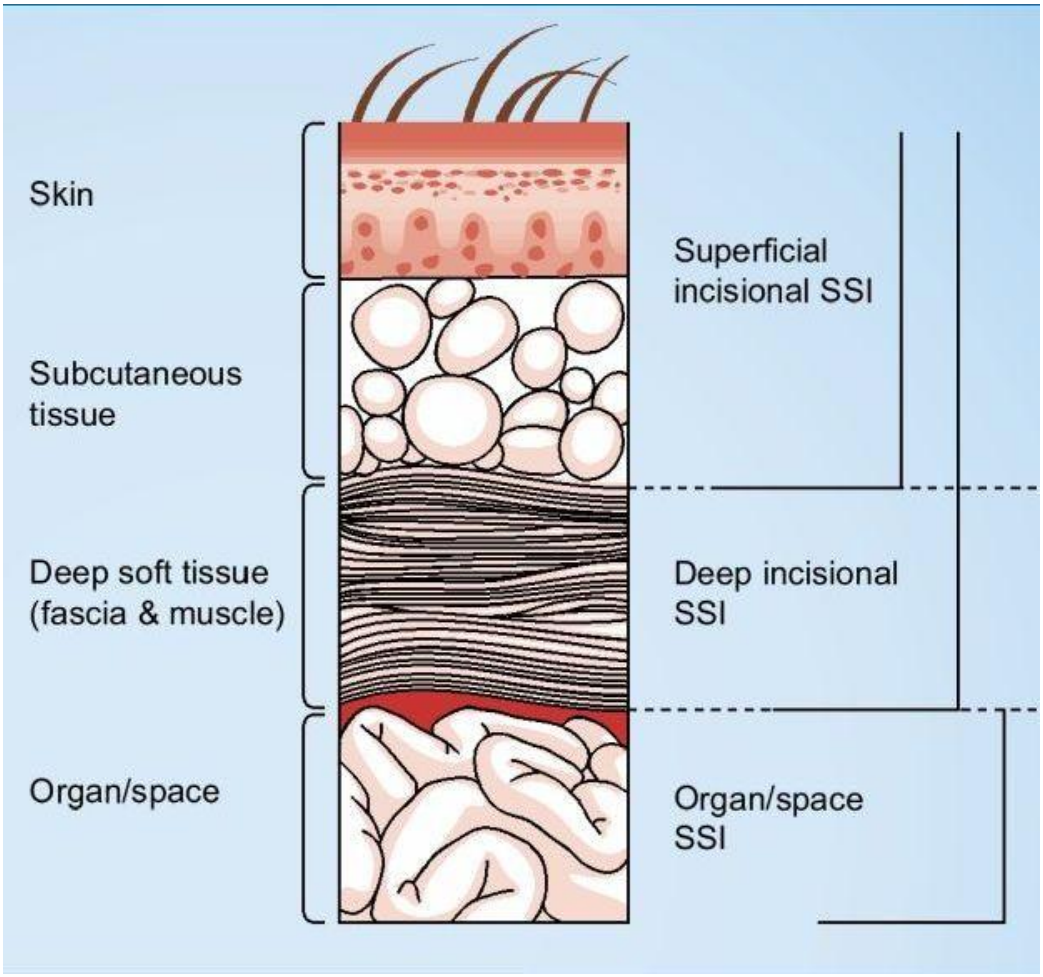
Comparison of NNIS Score and Wound Classification for Predicting Risk for SSI

NNIS RISK SCORE

Wound class	**0**	**1**	**2**	**3**	**All**
Clean	1.0	2.3	5.4	-	2.1
Clean-contaminated	2.1	4.0	9.5	-	3.3
Contaminated	-	3.4	6.8	13.2	6.4
Dirty	-	3.1	8.1	12.8	7.1
All	1.5	2.9	6.8	13.0	-

Diagnosis

CLASSIFICATION OF SURGICAL SITE INFECTIONS (SSI) [7]



D. ACCORDING TO THE DEPTH OF THE WOUND INFECTION

Superficial incisional SSI

- It developed within 30 days of operative intervention
- SSI's occur in skin and the sub-cutaneous fascia only and one of the following,

- pus drainage , micro organisms isolated from discharge fluid/ tissue of superficial incision site, atleast 1 sign's of inflammation,
- Wound is deliberately by the surgeon,
- Surgeon or the attending physician declares that the operative wound is infected with micro organisms.

Deep incison SSI

- It developed within 30 days of surgical intervention or 1 year if an any foreign body (implant) is present
- Occur in deep soft tissues of the incision site and

  at least 1of the following –
- Pus discharge from the deep surgical incision site without organ or interspace involvement,
- Fascial sepration or deliberate separation by the surgeon deep abscess identified by resurgery/ histopathology/ radiological investigation, surgeon or the attending physician declares deep infection present.

Organ space infection

- It developed within 30 days or 1 year if an any foreign body (implant) is present,
- Occurs anatomic structures not opened or handled during surgery and

One of the following –

- Purulent drained from the external drain kept in the visceral organ or organ space,
- micro organism identified by method of culture,
- presence of pus by direct examination/ resurgery/ histopathological examination/ radiological investigation,
- Identified by surgeon or attending physician.

CLINICAL PRESENTATION OF SSI'S

Clinically surgical wound infection unidentified upto 5th post operative day, but this kind of patient present with rise temperature starts prior in the post operative duration.

Local manifestations

1. active inflammation in the surrounding tissues (cellulitis)
2. pus formation in the wound site
3. Necrotising soft tissue infection- less commonly myonecrosis by the bacterium, clostridia. More dangerous nonclostridial infective tissue gangrene, Meleney's ulcer in the post surgical synergistic infection myonecrosis
4. Infection of the Intra abdominal organ and space.

Systemic manifestations

1. Post operative increase in body temperature
2. Spreading of micro organisms in the blood and septicemia

⇩

Systemic inflammatory response syndrome(SIRS)

⇩

Multiple organ dysfunction syndrome (MODS)

⇩

Multiple system organ failure

COMPLICATIONS

1. Wound dehiscence
    A. Incomplete
        Superficial- wound gaping
        Deep- Late incisional hernia
    B. Burst abdomen
2. Local stitch sinuses and abnormal connection between two epithelial surface
3. Collection of discharge after the use of antibiotics inform of antibiomas
4. Calcium deposition in the wound site and ossification
5. Regional lymph node infection secondary to local infection

6. Ugly keloid scar tissue result of healing

Normal bacterial Microbial Flora of the Human body

The term normal microbial flora implies array of microbial organisms which are normally present in human being.

They are classified as

-*Residents*

-*Transients*

The knowledge about normal flora becomes essential in the following:

- Interfere in the diagnosis due to their ubiquitous presence & resemblance to some pathogens.
- Preventing the colonization of pathogens
- Are *pathogenic* when host defense is impaired.

Normal flora of Intestinal tract:

Normally, Saliva and food swallows the micro organisms on the surface of oesophageal wall.

Also acidic pH of the stomach makes it virtually sterile (except in the immediate postprandial period).

These protective mechanisms fail in following conditions:

- *Carcinoma of stomach*
- *Achlorhydria*
- *Pyloric obstruction*

  Therefore, leading to proliferation of Gram positive cocci & bacilli.

Colonization of bacteria increases progressively from duodenum to the colon.

Bacterial range in intestinal flora of normal adult are as follows:

- Duodenum – 10^3-10^6 → Lactobacilli & E.coli predominate
- Jejunum & proximal ileum 10^5-10^8
- Lower ileum & ceacum 10^8-10^{10} → Resembles Faecal flora.
- Colon & rectum 10^{11} bacteria per gm. Constitutes 10-20% faecal mass.

The resident flora of normal adult colon:

a) Anaerobes (96-99%) - streptococci, clostridia, bacteriodes & lactobacilli
b) Aerobes (1-4%)- Enterococci, coliforms, proteus, pseudomonas, lactobacilli, mycoplasma & candida.

Normal flora of Genito-urinary tract:

Smegma of the genitalia of both men & women harbour *Mycobacterium smegmatis*, which is usually harmless.

Other organism present are: *Ureaplasma urealyticum & Chlam.trachomatis.*

- *The female urethra is either sterile or contains a few gram positive cocci*

Microorganisms most commonly causing surgical site infection

	Site of operation	Aerobic	An aerobic
1	Esophagus	Streptococci	Bacteriodes other than B.fragilis, peptostreptococci, fusibacterium
2	Gastric	Enteric gram negative bacilli, streptococci	Bacteriodes other than B.fragilis, peptostreptococci, fusibacterium
3	Biliary	Enteric gram negative bacilli, streptococci	Clostridia
4	Small bowel	gram negative Enteric bacilli,	Bacteriodes other than B.fragilis, peptostreptococci, fusibacterium
5	Large bowel	gram negative Enteric bacilli,	Bacteriodes other than B.fragilis, peptostreptococci, fusibacterium
6	Oral cavity	Streptococci	Bacteriodes other than B.fragilis, peptostreptococci, fusibacterium

PREVENTION OF SSI

In 1998, CDC issued a number of guidelines for reducing the risk of SSIs. They can be grouped as follows

OPERATING ROOM MEASURES:

Although all guidelines regarding intra operative operating room ventilation may not be financially possible they should be adhered to as much as possible.

A. VENTILATION

a. positive-pressure ventilation in the operating room with respect to the corridors and adjacent areas should be maintained
b. A minimum of 15 air changes per hour of which at least 3 should be fresh air should be ensured.
c. Air should be introduced the room at the roof, and exhaust near the ground of the room (floor).
d. Operating room doors should be kept closed except as needed for passage of equipment, personnel and the patient.
e. The number of personnel entering the operating room should be limited to necessary personnel

B. CLEANING AND DISINFECTION OF ENVIRONMENTAL SURFACES

Disinfectant must be used to clean the contaminated site before the next surgery, if there is naked contamination by the body fluid or blood or bowel content.

C. STERILISATION OF SURGICAL INSTRUMENTS

1. All surgical instruments should be sterilized according to published guidelines
2. Flash sterilization should be performed only for patient care items that will be utilized immediate . (example for this, process by second time of the instrument that fall accidentally). The recommendations therefore are:-
    a. Hair should not be removed preoperatively unless the hair at or around the incision site interferes with operation.
    b. If hair is removed, it should be removed immediately before this operation, preferably with electric clippers. [2]
    c. Serum blood glucose levels should be adequately controlled in diabetic patients.
    d. Stopping use of tobacco products should be encouraged preoperatively. Patients should be instructed to abstain from smoking for at least 30 days before elective operation

e. The incision site should be thoroughly washed and cleaned to remove gross contamination before performing antiseptic skin preparation
f. Whenever possible, all infections remote to the surgical site should be identified and treated before elective operation.
g. An appropriate antiseptic agent for skin preparation should be used. Wide prepping of the proposed incision site with antiseptic solution preoperatively helps keep microorganisms from migrating into the wound if the site towels or drapes become wet during surgery.

b. Hand/forearm antisepsis for surgical team members

1. Nails should be kept short
2. A preoperative surgical scrub should be performed for at least 2 to 5 minutes using an appropriate antiseptic. The hands and forearms should be scrubbed up to the elbows.
3. Wearing of hand or arm jewelers should be discouraged
4. surgical attire- a surgical mask that fully covers the mouth and nose should be worn throughout the operation.

A cap or hood that fully covers the hair on the head and face should be worn when entering the operating room.

Surgical gowns and drapes that are wet are ineffective barriers and should be avoided.

Scrub suits that are nakedly soiled with dirt or body fluid , contaminated fluid and/or feces, or by the blood or other potentially infectious body fluids must be changed

d. ASEPSIS AND SURGICAL TECHNIQUE

Tetanus toxoid immune prophylaxis is mandatory.

1. Principles of asepsis when placing intravascular devices, spinal or epidural catheters or when dispensing and administering intravenous drugs should be adhered to.

2. Good surgical techniques indispensable as it minimizes

1. Tissue trauma

2. controls bleeding,

3. Eliminates dead space,

4. Removes dead tissue and

5. Foreign bodies,

Uses minimal suture and maintains adequate blood supply and oxygenation.

Specifically, it is important to handle soft tissues gently to avoid crushing that can result in tissue necrosis.

Electro cautery should be sparingly to control bleeding because it leaves behind dead tissue that is more likely to become infected.

3. Absorbable sutures should be used whenever possible because permanent suture, especially silk suture, reduces the number of bacteria necessary to cause infection.

4. Closed suction drains that exit through a separate stab wound helps prevent accumulation of tissue fluid in the dependant portion of the wound. Preventing this is especially important in obese patients and may reduce SSIs.

Passive drains, such a Penrose drain, exiting through the bottom of the incision should not be used.

Maintain the blood circulation to the organ which is being operated.

Complete lavage of purulent materials with warm normal saline.

Confirm that patient is in normothermic state and fluid balance is maintained

Before closing the surgical wound confirm the all foreign body is removed or not.

Post operative care

Three natural methods to enhance the host response

1. Increase the oxygenation to the patient
2. Maintain ideal core boy temperature
3. Good glucose control
4. Proper antibiotic prophylxsis

e. ANTIMICROBIAL PROPHYLAXIS [16]

1. PREVENTIVE ANTIBIOTIC THERAPY

- It is used whenever high risk of infection is associated with the procedure and the consequences of infection if possibly severe and if a patient has high NNIS risk index.
- Prophylactic Antibiotics must be given as early to the skin incision as possible, and before anesthetic induction.
- Selected antibiotic should have activity against likely pathogens.
- Postoperative systemic antibiotic for 24 hours
- Benefit of postoperative antibiotics in NNIS risk 0 indexes is difficult to assess and quantify.
- Proper techniques and wound environment are more important than antibiotics.

- Preventive systemic antibiotics not to be used to prevent noscomial infections.
- Oral antibiotic bowel preparation with appropriate mechanical bowel preparation.
- If systemic antibiotics are to be used antibiotics of longer half life are to be chosen.
- Very long procedures should have a redosing strategy during the procedure.

2. ENHANCEMENT OF HOST DEFENCES

- Increased oxygen delivery facilitates phagocytes eradicating the microbes.
- Optimizing core body temperature is important as warmer patients resist bacteria better.
- Blood glucose control is essential even to non diabetics as well.

Experimental studies published during early 1960s helped to achieve a more scientifically accurate approach to antimicrobial prophylaxis .Most important was the report by Burke which demonstrated the crucial relationship between timing of antibiotic administration and its effectiveness of prophylactic use. burke studied experimentally result in, that the significant decrease in experimental skin infections affected by pencillin sensitive S.aureus , penicillin had to be in the skin shortly before or at the time of bacteria exposure .This

important change in strategy help correct the common error of first administering the prophylactic antibiotic in the recovery room.

As early as 1964, Bernard and Cole reported on the successful use of prophylactic antibiotic in the randomized prospective placebo control clinical study of abdominal operation on GI tract.

A prophylactic antibiotic should be used only when indicated.

1. The initial dose of prophylactic antimicrobial agent should be administered by the i.v route, time such that at the bacterialcidal concentration of the drug is established in serum and tissues when the incision is made. Therapeutic levels of the agent in serum and tissues should be maintained throughout the operations and until a few hours after the incision is closed.
2. The use of antibiotics preoperatively can reduce the rate of infection, particularly wound infections, after certain operations. For most procedures, an in-expensive ,first or second generation cephalosporin ,which has a moderately long half-life and is active against staphylococci and streptococci ,has been effective when given IV 30 minutes before surgery.
3. Also, third and fourth generation cephalosporin should not be used for routine surgical prophylaxis because they are expensive, their spectrum of

activity includes organisms rarely encountered in elective surgery and their widespread use may promote the emergence of resistance.

Prophylactic Antibiotic before elective large bowel resection

Our large bowel and ileum contain an enormous (anaerobic bacteria) micro-organisms which is entirely separate from the body by the mucous membrane of bowel.. A reliable method sterilizing the colonic contents has been a goal of surgeons for the century, In the past 25 yrs, clinical trials has demonstrated that to substantially reduce the septic complication after elective colon surgery, antibiotics must have activity against colonic aerobes (eg. E.coli) and anerobes (eg. Bacteroides fragilis). Model approaches include standard outpatient mechanical cleansing dietry restriction, cathartics, and enema for a two day period for foregut lavage with an electrolyte solution of 10% mannitol.

Fleet's phospho-soda , or poly ethylene glycol, than the day before the operation.

Most surgeons use both antibiotic and mechanical cleansing for preoperative preparation before elective colon resection. The most popular regimen in USA has been neomycin-erythromycin based preparations, which was introduced in 1972.

Antibiotic prophylaxis for appendectomy

Pathologic state of appendix is the most important determinant of post operative infection. Wound infection after appendectomy for perforative or gangrenous appendicitis is 4 to 5 times higher than for higher disease. The parentral antibiotic agent is recommended as prophylaxis in all patients.

Antibiotic prophylaxis in urogenital surgeries

Antibiotic prophylaxis is recommended in transrectal prostrate biopsy, in ESWL, in PCNL, endoscopic uretric stone removal and highly recommended in TURP. This is to prevent bactereruria , urinary tract infections and subsequent uro sepsis. Gram negative bacilli and entero cocus are predominant organisms. Cephazolam is the recommended drug and ciprofloxacin is the alternative antibiotic.

Antibiotic prophylaxis in upper GI surgeries

Antibiotic prophylaxis is recommended in gastric surgeries including gastric bypass and intestinal surgeries. Organism include enteric gram negative bacilli and gram positive cocci. Preferred antibiotic for prophylaxis is cefazolin and clindamycin+ aminoglcoside being in the alternative regimen.

Prophylactic Antibiotic therapy in hepato-biliary operation

Antibiotic prophylaxis is recommended in biliary and pancreatic surgery, liver surgery and in increased risk patients for GB surgery. However the patients undergoing routine laparoscopic cholecystectomy surgery in general risk patients, antibiotic prophylaxis is not recommended. Micro-Organisms include enteric gram –ve bacillus and gram +ve coccus. Preferred antibiotic for prophylaxis is cefazolin and clindamycin + aminoglycoside being the alternative regimen.

Antibiotics used commonly in surgical site infection & Antimicrobial coverage

Drug	**Antibiotic coverage**
Pencillin G	Streptococcal species except enterococci and pencillin resistant pneumococci
Methicillin	Staphylcocci and streptococci except enterococci
Ampillicin	Streptococci, enterococci,Haemophilus ,E.coli,Proteus
Amoxicillin	Streptococci, enterococci,Haemophilus ,E.coli,Proteus
Piperacillin	Pseudomonas,Acinetobacter,Gram negative streptococci
Cefazolin	Streptococci *except enterococci,* Staphylcocci
Cefotaxime	Gram negative bacilli *except Pseudomonas,Acinetobacter*
Cetriaxone	Gram negative bacilli *except Pseudomonas,Acinetobacter*

Cefaperazone	Gram negative bacilli *including Pseudomonas ,Acinetobacter and Serratia sp*
Ceftazidime	Gram negative bacilli *including Pseudomonas ,Acinetobacter and Serratia sp*
Cefepime	Gram negative bacilli including Pseudomonas ,Acinetobacter and Serratia sp with *additional Gram positive activity*
Meropenam	Extremely broad spectrum antibiotic with *both Gram positive and negative aerobic and anaerobic activity*.
Ciprofloxacin	*Broad gram negative activity* .Poor activity against anaerobes
Gentamicin	Gram negative bacilli,Enterococci and serratia sp
Amikacin	Gram negative bacilli,Enterococci and serratia sp and Gentamycin resistant organisms
Metronidazole	Active against anerobes,protozoa. *Inactive against facultative and aerobic bacteria*
Vancomycin	Streptococcal sp, Staphylcocci including resistant sp & Clostridium .*No activity against Gram negative rods*
Linezolid	Gram positive organism *including methicillin and vancomycin resistant organisms.*
Tetracycline	Gram positive and some gram negative organisms

MANAGEMENT OF SSI

- SSI is managed depending upon the type of SSI – superficial , deep or space.
- All infected necrotic sloughed material, purulent drain should be removed from the wound site
- Allow the wound to drain freely by removing the suture materials.
- Culture of the pus or necrotic material and antibiotic sensitivity of the purulent fluid or necrotic materials must done to start earlier antibiotics
- Infected surgical wound is managed until the mature granulation tissue is developed and leaves them to heal by secondary intention.

Antibiotics with Predominantly Aerobic or Anaerobic Broad-Spectrum Activity

Aerobic	*Anaerobic*
Gentamicin	A penicillin with a β- lactamase inhibitor
Tobramycin	Clindamycin
Amikacin	Metronidazole
Netilmicin	Chloramphenicol
Cefotaxime	
Ceftizoxime	
Ceftriaxone	
Ceftazidime	
Cefepime	
Aztreonam	
Ciprofloxacin	
Ofloxacin	
Levofloxacin	

MATERIALS AND METHOD

Collection of material

The following clinical material was collected in prospective study, Patients selected from General surgical ward at TVMCH admitted between March 2012- May 2013.

Patient with clean postoperative wounds were excluded from the study. Only clean contaminated, contaminated, dirty wounds were included in this study.

The operative wounds site was look for the Signs/Symptoms of inflammation and presence of micro organisms (infection) in the

1. post operative period of all patient in abdominal surgeries,
2. during wound cleaning and
3. dressing or if the dressings is soaked with discharge,
4. until the patient get discharged from the hospital and
5. Also in the OPD after discharge.

When surgical site infection was clinically raised, the area around the operative wound was Cleaned with 70% ethyl alcohol. The discharge was collected from the depth of the surgical

Wound using 2 sterile cotton swabs, the material was aspirated in a container which is sterile or the swab is send whenever the previous one is failed

The wounds site and the samples or pus collected were examined for characteristics that Indicate infection, which include foul smell, brick red fluorescence, black sloughed necrotic tissue or black discharge blood and purulence.

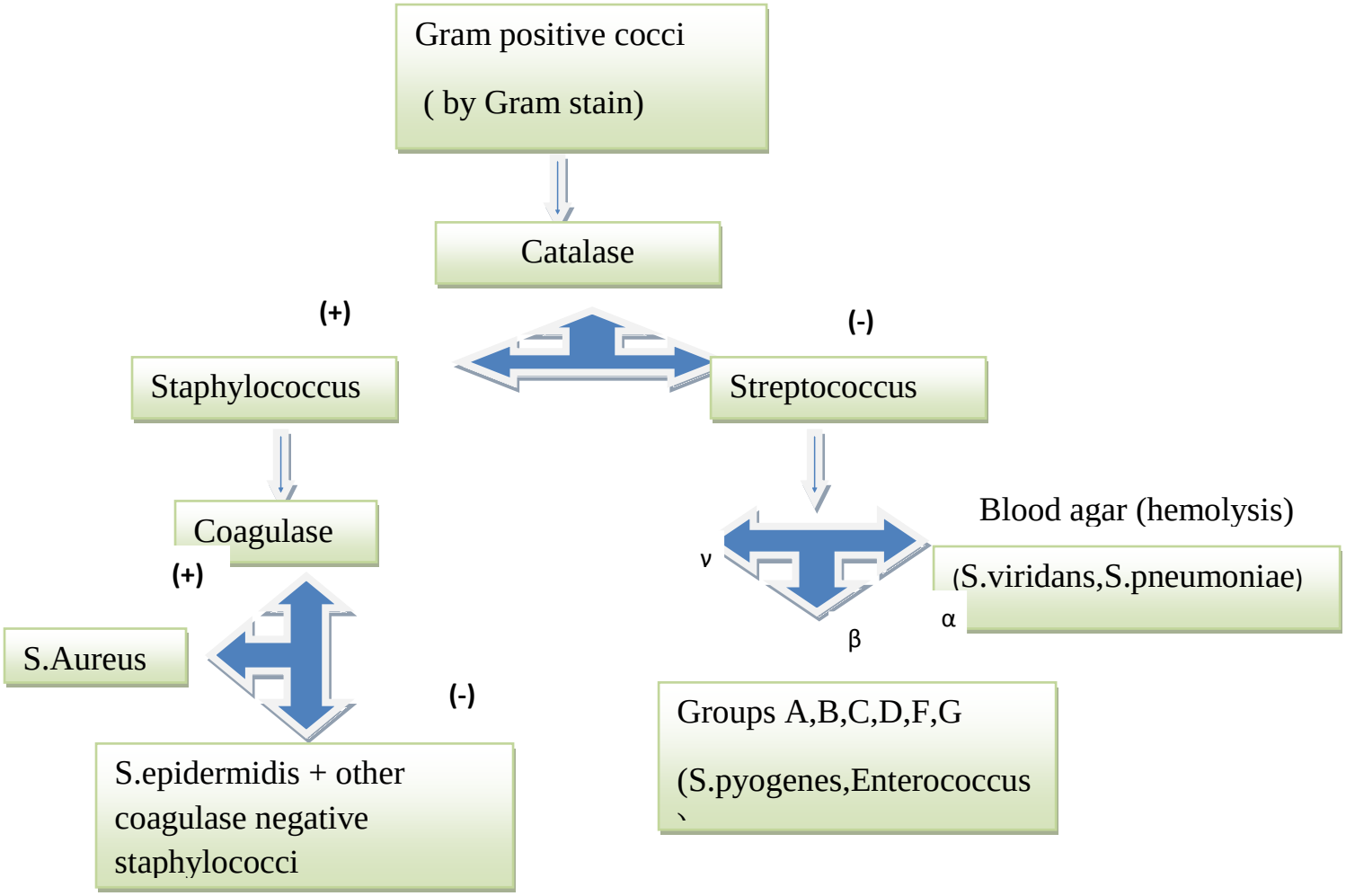
TRANSPORT

All the swab/pus collected was transported earlier to the lab for Next step of processing. The culture media is incubated at 37° C temperature.

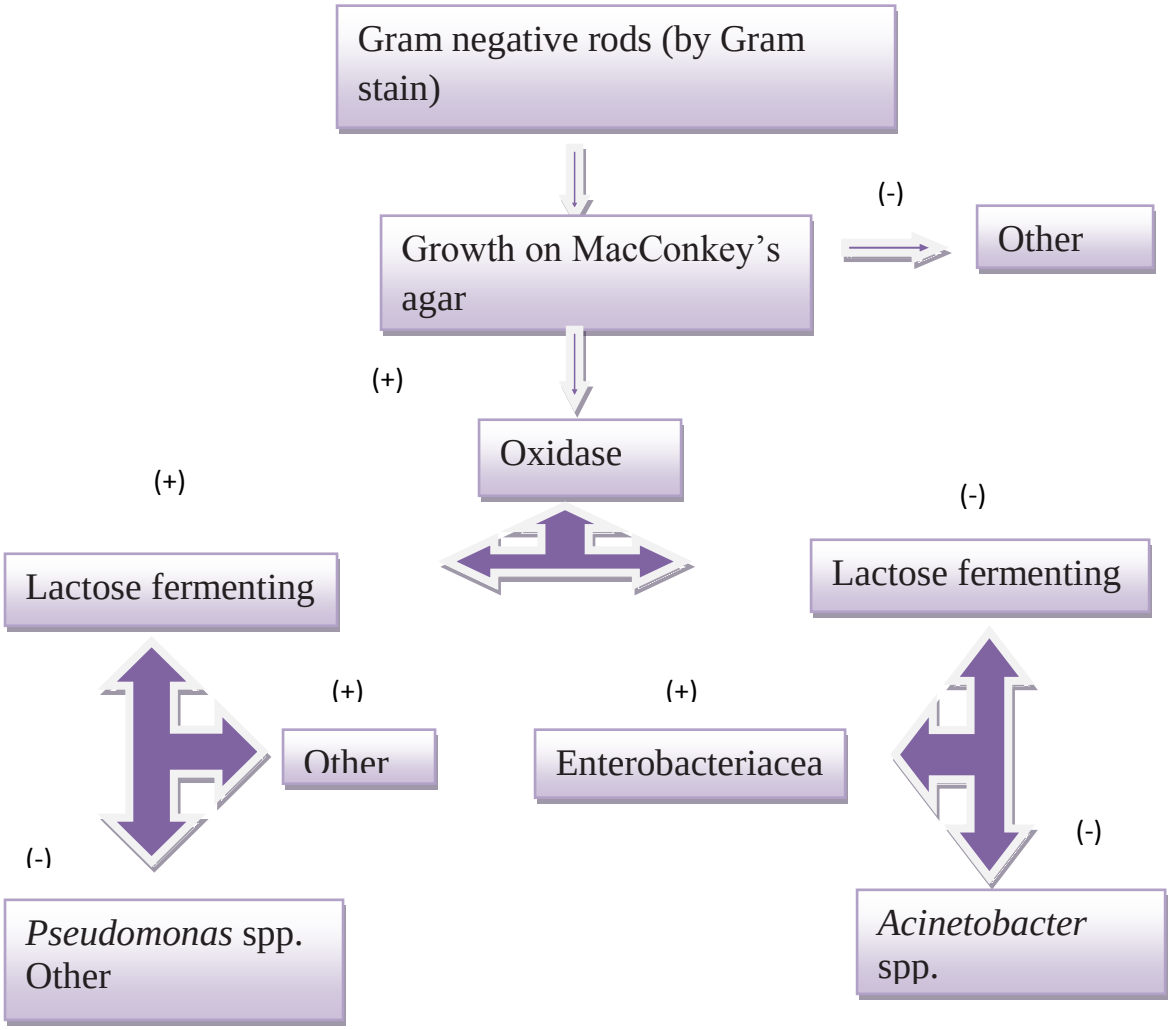
METHODS

The collected samples pus material was processed as:

a. Identification of bacteria under direct microscopy by gram stained smear of collected materials.
b. Culture media were used to Inoculation of the samples for aerobic micro organisms
c. Initial identification of micro organisms
d. Culture and Antibiotic sensitivity



Algorithm to identify specific pathogens within gram positive cocci



Algorithm to diagnose specific organisms within Gram negative bacilli

Patients analyzed for risk of surgical site infection by applying major and minor criteria. [17]

FACTORS INFLUENCING POST-OPERATIVE WOUND INFECTIONS.

A number of pre-operative, per-operative and post-operative risk factors have been studied to find their influence on the incidence of post-operative wound infections.

The results are variable, because the incidence of infection always depends on a combination of factors and never a single factor[4,12,24].

1) Wound Class:

Various investigators have developed methods to stratify populations of patients into categories of risk for post-operative wound infections.

2) Age:

Extremes of age have been thought to influence the likelihood of wound infections, owing to decreased immuno competence.

Mead et al, (1986) demonstrated an increased clean wound infection rate of 2.7% in patients less than 1yr old, those more than 50 years a rate of 2.8% and those 1 to 50 years old, a rate of 0.7% [25].

3) Preoperative Hospitalization:

Patients who have a longer duration of pre-operative hospitalization are more likely to develop post operative wound infection [20].

In the NRC Ultraviolet study 1964, the infection rate was 6% when the preoperative hospitalization was 0 to 1 day and 14.7% when it was over 21days 8. Cruse and Foord in both their studies (1973,1980) observed that, patients hospitalized for 0 to 1 day ahad a clean wound infection rate of 1.2%, whereas, those hospitalized for more than two weeks had a 3.4% infection rate [10].

4) Preoperative Shower

A preoperative shower with an antiseptic soap such as Chlorhexidine or Povidone iodine can reduce the resident skin bacteria, especially in hospitalized patients who may have increased skin bacteria [5,1]. Cruse reported that incidence of infection fell to 1.3% in patients taking a preoperative shower using a soap containing Hexachlorophene, but in patients who took a shower using an ordinary soap, it was 2.1 % and in those who did not shower, the rate of infection was 2.3% [10].

5) Preoperative preparation of operative site:

In 1976 Alexander et al, observed that if hair not removed at the surgical site the less chance of wound infection rate for clean surgical wounds was noted. depilatory is preferable to clipping, If hair removal is necessary, which is preferable to shaving. Any hair removal should be done as close to the time of incision as possible [5]. Razor shaving of the operative wound site on the day

before an operation, drastically increases the infection rate. This increase is caused by the growth & multiplication of the skin micro organisms in the damaged epithelium. This was supported by the study conducted in 1977 by Mary Olson et al, who reported a reduced in wound infection rate from 6% to 1.9% [26].

6) Length of Operation:

Duration of the operative surgical procedure had Risk factor for wound infection has repeatedly shown to be proportional to it.

In l960 Lindell noted that the length of duration of operation has role in the wound infection is not dependent of the other risk factors which was analysed. This conclusion was proved by the study conducted in 1964 by the NRC/NAS[8].

At both the 5 and 10 years of the Foothills hospital study Cruse and Foord found that with longer duration of procedures, roughly 2 times of increase in chance of wound infection with every hour of the procedure [10].

7) Other Factors:

The patho-physiology of impairment of surgical wound healing in diabetics mellitus is not clearly understood, many studies indicate that it is a marked risk factor for wound infection and wound healing. The original study by Foord for 5-year, study reported showed that, in diabetics, the clean surgical wound infection rate was 1.7% when compared with an overall infection rate of 1. 8 % [10].

Major criteria

1. Nature of operation	Elective	Emergency
2. Type of wound	Clean contaminated	Contaminated
3. Type of surgery	Gastro intestinal	Hepatobiliary
4. Preoperative hospital Stay	Early/<2 weeks	Late/>2 weeks
5. Order of surgery (I,II Or III round) & Duration Of surgery	Early/<2 hours	> 2 hours
6. Other predisposing Factors (anaemia & Malnutrition, DM and Malignancy)	Absent	Present
7. Pre operative antibiotics	Given	Not given

Minor criteria

1.	Age distribution	Younger	Elder
2.	Sex	Male	Female
3.	Seasonal variation	Summer	Winter
4.	Pre operative hair Removal	1 hour before	1 day before

One point was given to the risk factors to the factors mentioned in column A and two were points given to the factors mentioned in column B. Incidence of wound infection more when score is high.

OBSERVATION

Total no. of patients studied - 458

- Surgical wound healed by 1st intention - 425

- Surgical site infection present clinically. - 33

Incidence of surgical site infection - 7.2%

Nature of surgery:

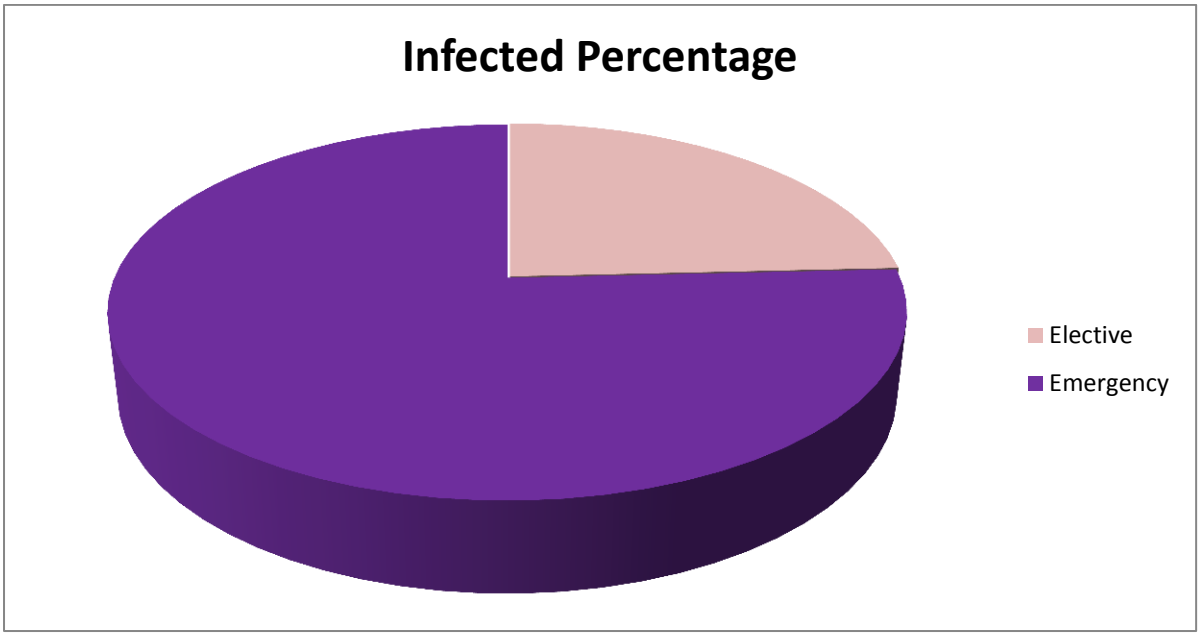
Out of 458 patients

249 Elective cases – 8 cases infected

209 Emergency cases – 25 cases infected

Table 1:

S. No	Surgical procedure	Total cases	Infected cases	Percentage
1.	Elective	249	8	3.21
2.	Emergency	209	25	11.9
	Total	458	33	7.2



2. Type of wound

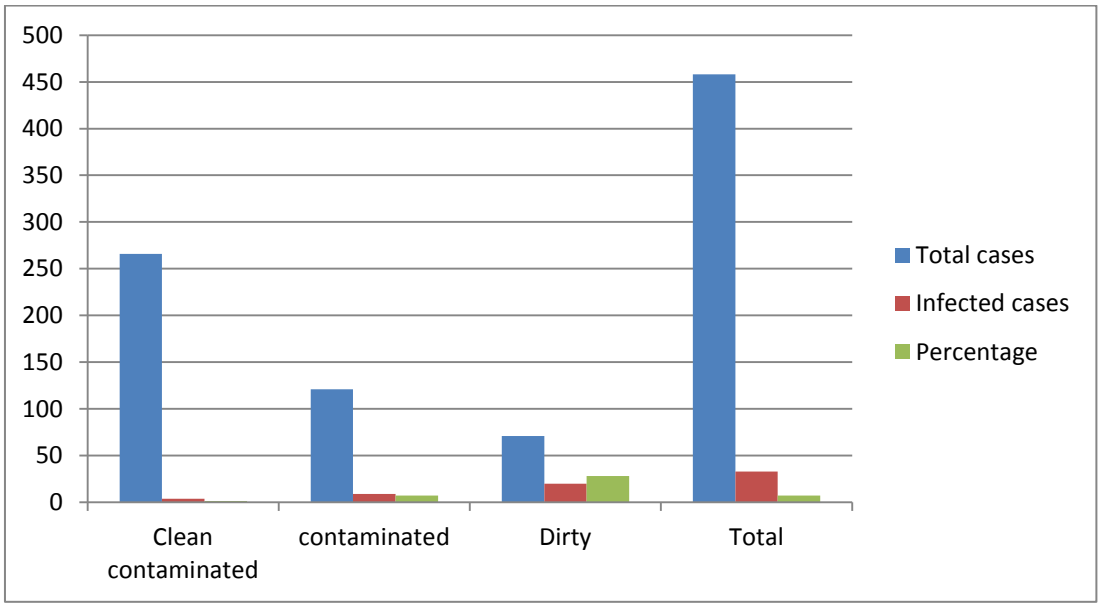
A. Clean contaminated

b. Contaminated

c. Dirty

Table 2.

S. No	Type of wound	Total cases	Infected cases	Percentage %
1.	Clean contaminated	266	4	1.50
2.	Contaminated	121	9	7.43
3.	Dirty	71	20	28.16
	Total	458	33	7.20

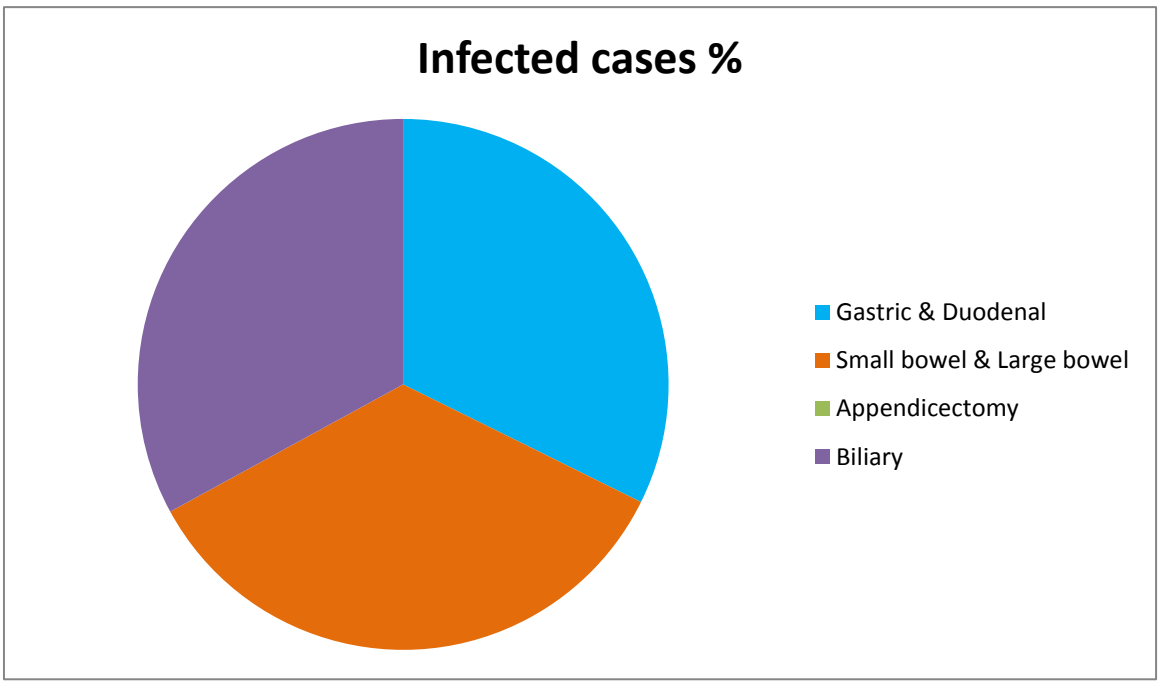


Infection rate is higher in dirty, contaminated, and clean contaminated in decreasing order.

3. Type of Surgery:

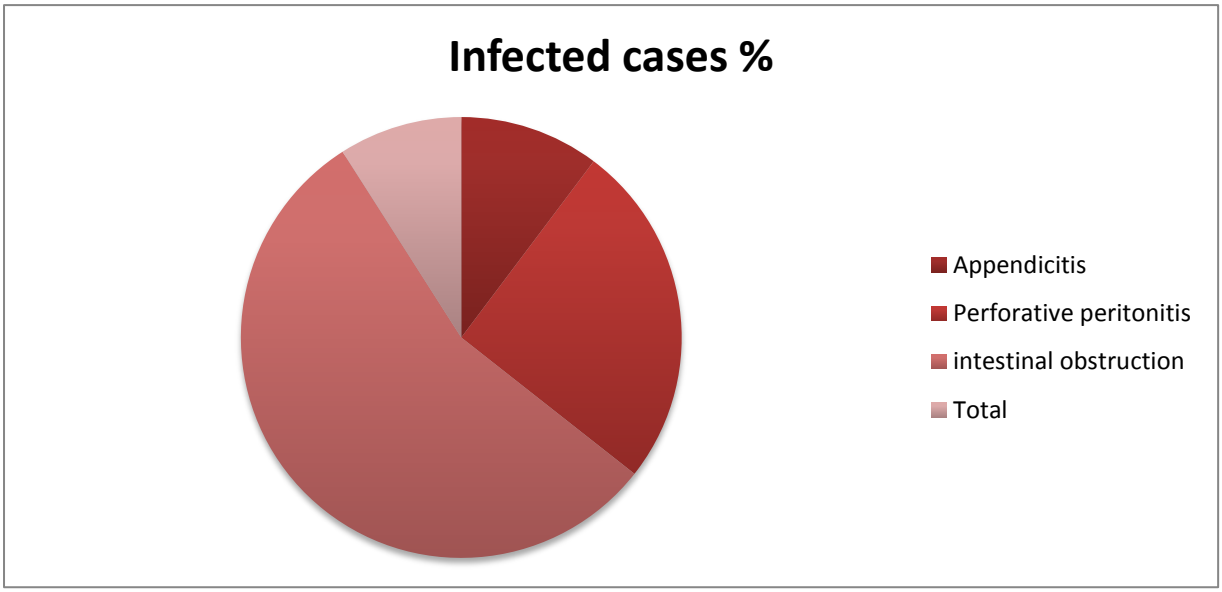
Elective

S. No	Surgical procedure	Total cases	Infected cases	Percentage %
1.	Gastric & Duodenal	50	3	6
2.	Small bowel & Large bowel	31	2	6.45
3.	Appendicectomy	119	0	0
4.	Biliary	49	3	6.12
	Total	249	8	3.21



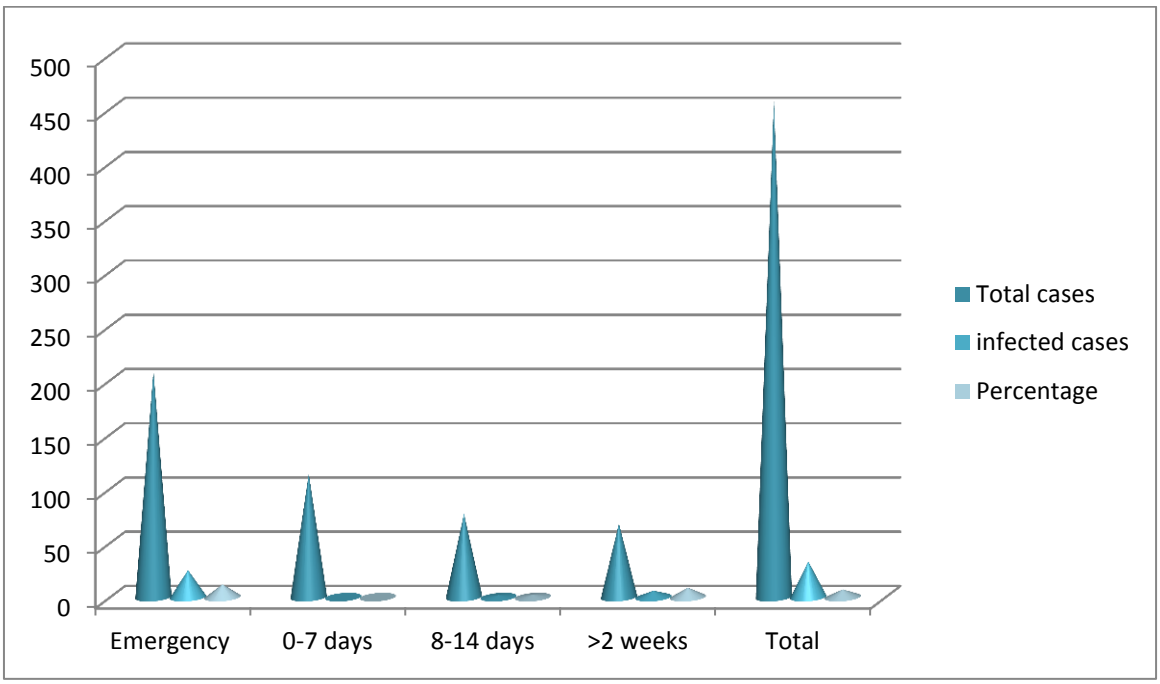
Emergency

S. No	Surgical procedure	Total cases	Infected cases	Percentage %
1.	Appendicitis	98	5	5.10
2.	Perforative Peritonitis	71	9	12.6
3.	Intestinal Obstruction	40	11	27.5
	Total	209	25	11.9



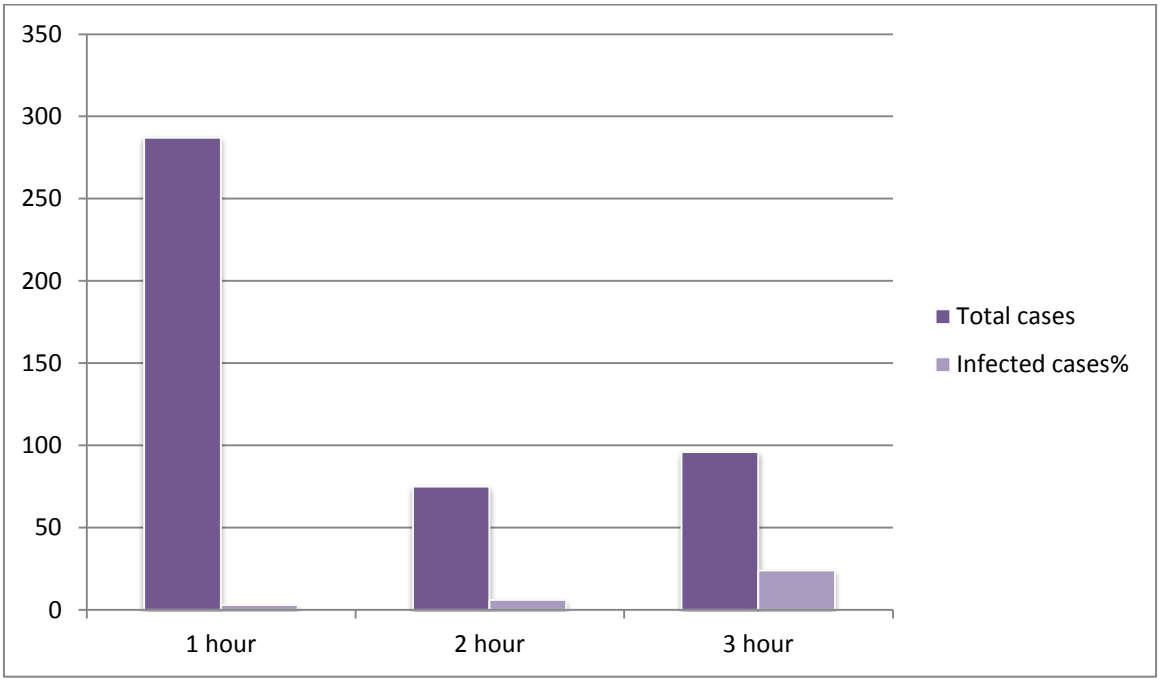
4. Preoperative Hospitalisation

S. No	Preoperative Hospitalisation	Total cases	Infected cases	Percentage %
1.	0 Emergency	209	25	11.9
2.	0-7 days	104	0	0
3.	8-14 days	77	2	2.59
4.	>2 weeks	68	6	8.8
	Total	458	33	7.2



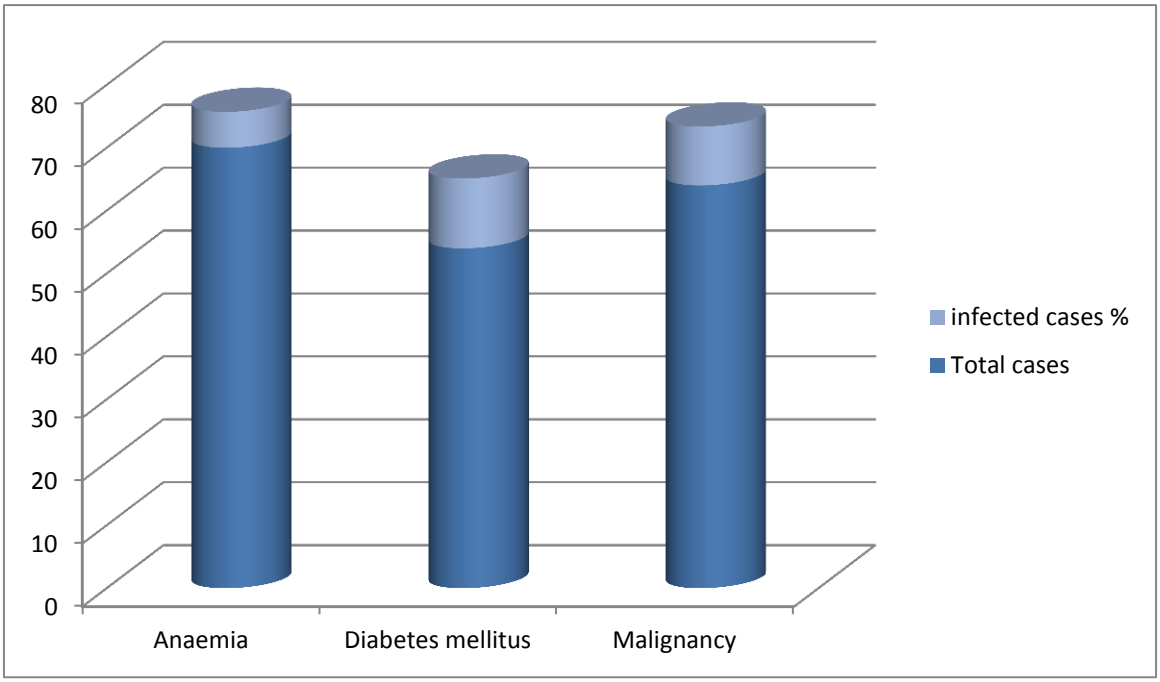
5. Duration of surgery

S. No	Duration	Total cases	Infected cases	Percentage %
1.	1 hour	287	3	1.04
2.	2 hour	75	6	8
3.	3 hour	96	24	25
	Total	458	33	7.2



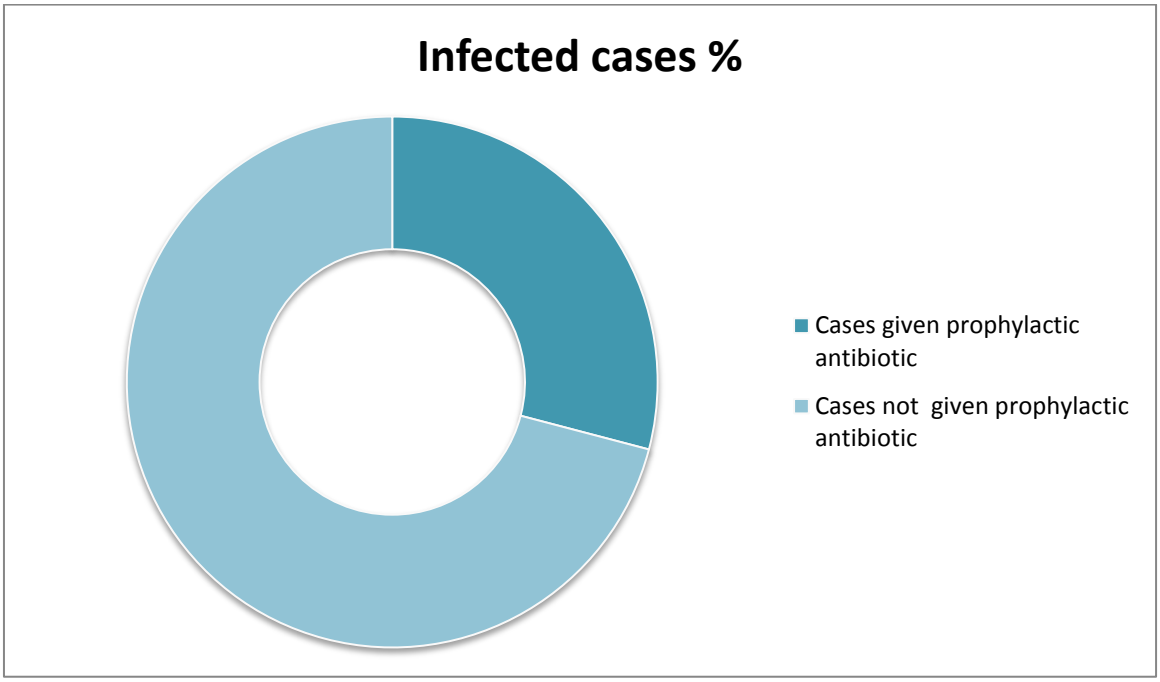
6. Predisposing factor vs Surgical site infection:

S. No	Predisposing factor	Total cases	Infected cases	Percentage %
1.	Anaemia <9gm%	70	4	5.71
2.	Diabetic mellitus	54	6	11.1
3.	Malignancy	64	6	9.37
	Total	188	16	8.51



7. Antibiotic Prophylaxis:

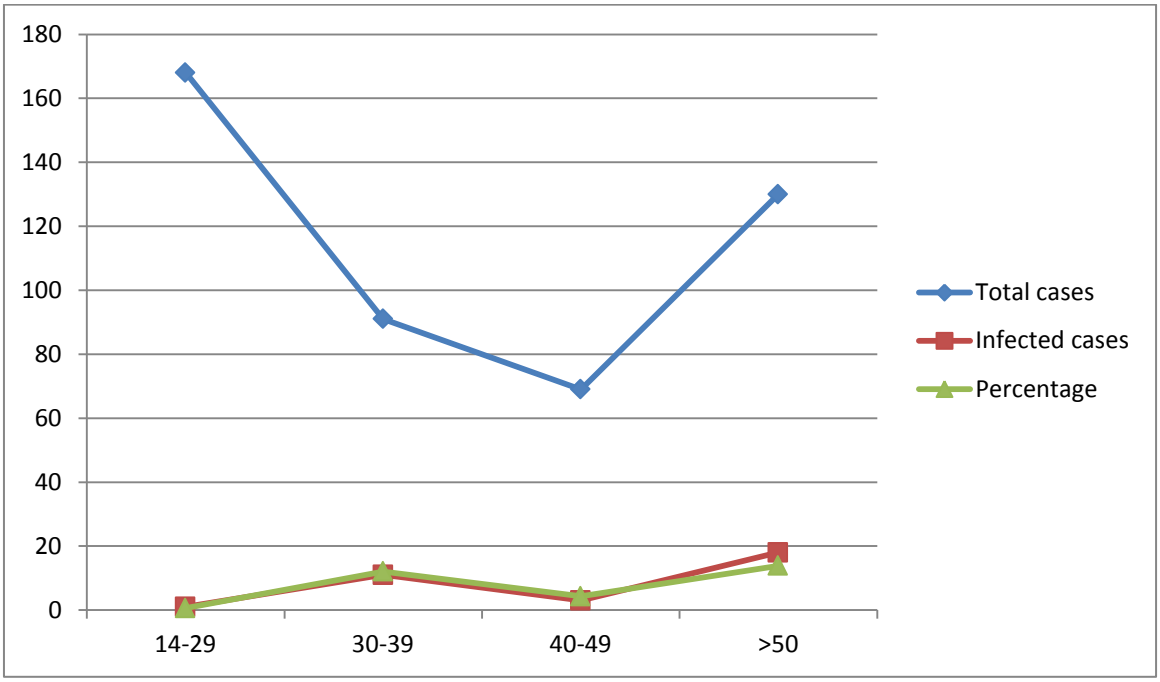
S. No	Antibiotic prophylaxis	Total cases	Infected cases	Percentage %
1.	Cases given prophylactic antibiotic	124	2	1.6
2.	Cases not given prophylactic antibiotic	125	6	4.8
	Total	249	8	3.2



Minor criteria:

1. **Age distribution**

S. No	Age distribution	Total cases	Infected cases	Percentage %
1	14-29	168	1	0.59
2	30-39	91	11	12.08
3	40-49	69	3	4.3
4	>50	130	18	13.84
	Total	458	33	7.2



2. Sex Distribution:

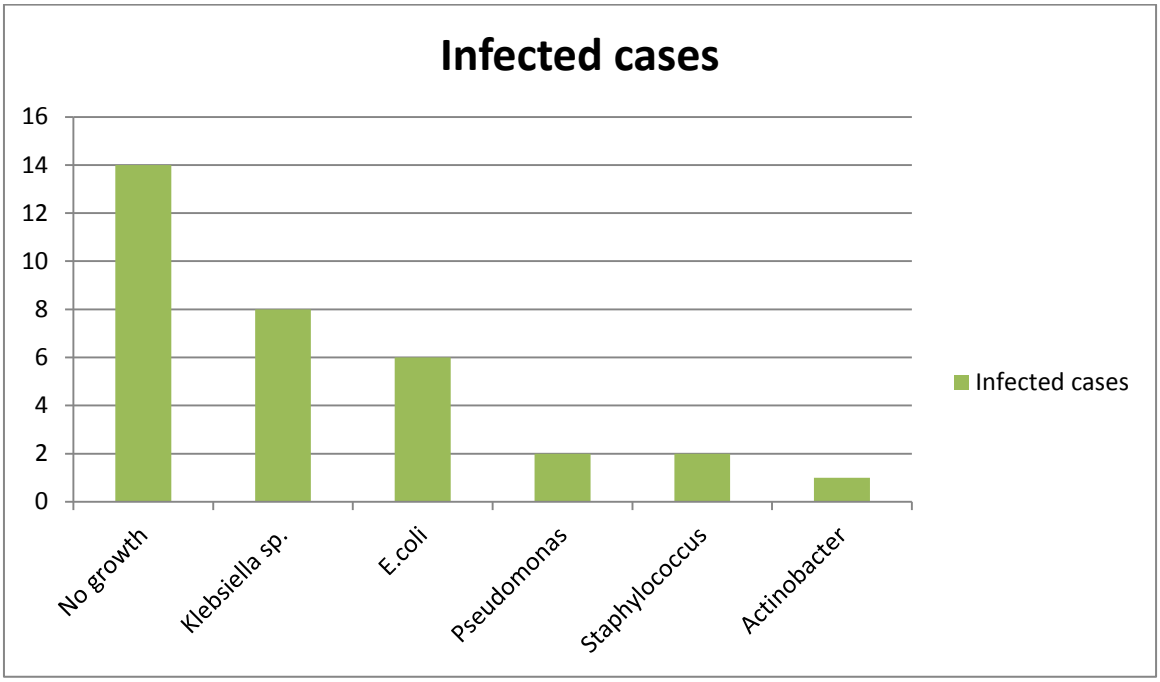
S. No	Sex Distribution	Total cases	Infected cases	Percentage %
1	Male	275	28	10.1
2	Female	183	5	2.73
	Total	458	33	7.2

3.Preoperative Hair removal

S. No	Preoperative Hair removal	Total cases	Infected cases	Percentage %
1.	1 hr before surgery	209	8	3.8
2.	1day before surgery	248	25	10.08
	Total	458	33	7.2

4. Bacteriological surveillance

S. No	Name of the organism	Infected cases	Percentage %
1.	No growth	14	42.42
2.	Klebsiella sp.	8	24.2
3.	E.coli	6	18.18
4.	Pseudomonas	2	6.06
5.	Staphylococcus	2	6.06
6.	Actinobacter	1	3.03



5. Antibiotic sensitivity

Organism	Ciprofloxac	Ampicillin	Amikacin	Doxycyclin	Cefotaxime	Cephalexin	Cetriaxone	Ceftazidim	**Cefaperazon**	Gentamcin	Tetracyline	Cefoxitin	Vancomyci	Teicoplanin	Imipenam
Klebsiella sp.	+		+	+	+			+	+	+					
E.coli		+	+	+	+	+	+								+
Pseudomonas	+						+	+	+						
Staphylococcus	+	+									+	+	+	+	
Actinobacter			+						+	+					

Fig 1. SSI in intestinal obstruction

Fig 2. SSI in appendicular perforation

Fig 3. SSI in duodenal perforation

Fig 4. SSI in intestinal obstruction

DISCUSSION

The incidence of postoperative infection (Surgical site infection) as studied by various authors are given below:

S. No	Name of authors	Years of study	Percentage
1.	Agarwall *et al*	1972	20
2.	Subramanian *et al*	1973	23
3.	Rao *et al*	1975	25
4.	Doig *et al*	1976	28
5.	T.V.Taylor *et al*	1984	26
6.	M.A.Khan *et al*	1985	20.2
7.	Donald *et al*	1985	10.2
8.	Butalari *et al*	1996	12.4
9.	Jeffrey *et al*	1998	4.4
10.	Targarone *et al*	2000	1.2
11.	Philip .S.Brachman *et al*	2001	2.4
12.	Present study	2005	11.8
13.	Robertson	1958	9.3
14.	Williams et al	1959	4.7
15.	Cruse & Foord	1980	4.7
16.	Edwards	1984	2.8
17.	Anvikar et al	1999	6.09

18.Eveline P.et al	2000	3.1
19.Present Study	2005	3.6

Surgical site infection is one of the major challenges for the surgical team. In our study, we tried to know the different kind of bacteria responsible for postoperative wound infections and their antibiotic sensitivity and correlate the microorganism with various risk factors.

Our study surgical site infection was done in the patient who underwent operation in Dept of General Surgery, Tirunelveli Medical college Hospital, Tirunelveli. Totally we studied 458 patients of abdominal surgeries out of which 266 cases were clean contaminated, 121 cases were contaminated and 71 cases were dirty wounds. Out of which 33 surgical site infection were confirmed by microbiological study, so the net infection rate was 7.2%.

When compared to other studies the infection rate is 2.8 to 17%, so infection rate of our study 7.2% is within these limits.

Surgical site infection in our study, Out of 458 cases, 249 were elective and 209 were emergency cases . Only 8 were infected in 249 elective cases compared to 25 infected in emergency cases.The infection rate was higher in emergency cases as double as when compared to elective cases which is due to delay in presentation to our hospital or taken treatment elsewhere and brought

the patient to our hospital after established infection (Peritonitis) and few of them developed prenal hypotension.

Our study ,among cases of 458, 266 cases were clean contaminated,121 cases were contaminated and 71 cases were dirty wounds in which 4 cases were in clean contaminated, 9 in contaminated and 20 in dirty wounds. The percentage of infection is higher in dirty wounds 28.16% when compared to contaminated 7.43% and clean contaminated wounds 1.5%.This shows the type of wound also influence the risk of surgical site infection.

In our study total no of elective cases studied were 249 ,among 249 cases highest is appendicectomy 119 cases in which there was no surgical site infection. 3 cases of surgical site infection were noted in hepatobiliary tract surgeries with incidence of 6.12 %. Total no of gastric and duodenal surgeries were 50 from which about 3 cases were infected incidence of surgical site infection was 6%. In cases of small bowel and large bowel surgeries ,studies conducted in 31 cases showed infection in 2 cases with incidence rate of 6.45%. The infection rate was higher in gastric ,duodenal and intestinal surgeries .

In our study ,total no of emergency cases were 209 , among which 98 cases were appendicitis in which 5 cases were infected with surgical site wound infection rate of 5.1%, 71 cases were perforative peritonitis in which 9 cases were infected with infection rate of 12.6%,40 cases of intestinal obstruction ,11 were infected with incidence rate of 27.5%.Infection rate was higher in case of

intestinal obstruction 27.5% when compared to perforative peritoinits 12.6% and appendicitis 5.1%.The rate of infection was encountered in emergency cases due to delay in presentation to our hospital or taken treatment elsewhere and brought the patient to our hospital after established infection (Peritonitis) and few of them developed prenal hypotension.

Preoperative hospitalisation plays important role in wound infection as bacteria colonises in patient during their stay. Our study also shows that there is increase in rate of incidence of infection in longer hospitalised patient ie the infection rate increases from 2.59% for stay 1-2 weeks to 8.8% for beyond 2 weeks. Emergency cases 209 ,25 cases were infected with infection rate of 11.9%. The reason for this longer stay of patients is mainly due to complexity of concurrent illness and need to improve his general and immune status.

In our study among 458 cases,287 cases surgery was completed in 1 hour ,75 cases was done within 2 hour and 96 surgeries lasted beyond 3hour.Infection rate was higher for longer duration surgeries beyond 3 hour 25%, 8 % for less than 2 hour and 1.04% for cases finished within 1 hour. This reveals that as the duration of surgery increases , there is a increased exposure of bacteria from exogenous sources and contamination of wound. This risk further related to the length of incision and local tissue damage.

In our study the various predisposing factors influencimg surgical site infection were also considered. The study showed 188 cases with some

predisposing disease in anemia was more prevalent when compared to other condition like malignancy and DM. Among 70 anemic patients 4 were infected with icdence rate of 5.71%, 54 were Diabetic and among which 6 were infected with infection rate of 11.1% , 64 cases were malignancy and among which 6 were infected with infection rate of 9.37%. The increase in incidence of surgical wounds in these conditions is due to poor glycemic control and immunosuppressive status of the patient.

In 2002,Rajeev M.Joshi, Mehta N.N *et al* studied the efficacy of Netilmycin and ceftriaxone as prophylactic antibiotics and showed a success rate of 98.1% in clean contaminated and 84.04% in contaminated cases with infection rate of 1.29% and 15.96% respectively. In our study injection cefatoxime sodium 1gm i.v along with inj.metroniadole 500mg i.v was used. Out of 249 elective cases studied.124 cases were given prophylactic antibiotics the infection rate is 1.6%, 125 cases were not given prophylactic antibiotics infection rate is 4.8%.

In 1996,Butalari, A.., Ferri,M. *Et al* studied the probability of operative mortality and morbidity in a large number of patients over 80 yrs of age. Postoperative mortality and morbidity were 10.1 & 32.2% respectively which was higher when compared with mortality and morbidity rate in younger patient which was 1.2 & 12.4 % respectively. In our study cases infected in age group

of 14-29 is 0.59% when compared to elder age >50 yrs 13% higher when compared to 0.59% 0f age group 14-29.

In our study antibiotic sensitivity of the organisms, Gram negative organisms like kleibseilla,E.coli,Pseudomonas were more sensitive to ciprofloxacin,amikacin, ,cefaperazone sulbactam.

The incidence rates vary in different studies probably due to alteration in interpretation of surgical site infection. Based on the studies of Cruse and Foord Clean wounds infection rate is better indicator for control of infection than overall incidence.

In our study infection rate among clean wounds is 1.5%, whereas in contaminated and dirty wounds it was 7.43 & 28.16 respectively. Higher rate of infection in contaminated and dirty wounds is due to endogenous contamination.

The incidence rate in clean wounds in our study of 1.5%, is slightly higher than those of the other studies in Canada & U.S. and lower than the rates observed by Anvikar et al, [12] and Ojiegbe et al [34].

It is evident that rate of surgical site infection can be reduced by use of preoperative and appropriate postoperative antibiotics and improving sterilization techniques. Also our study shows that increasing age increases risk of infection ie. 0.59% in age group 14-29 to 13.84% for age >50yrs.

According to Cruse and Foord, Older patients develop infection in clean wounds than younger patient [18, 19] These age factors gain importance in dealing with infection due to presence of co-morbid condition (DM, HT, Chronic illness requiring steroids) and reduced immunocompetence in older patients. Also smoking and alcoholism play a role in wound infection.

Preoperative hospitalisation plays important role in wound infection as bacteria colonises in patient during their stay. Our study also shows that there is increase in rate of incidence of infection in longer hospitalised patient ie the infection rate increases from 2.59% for stay 1-2 weeks to 8.8% for beyond 2 weeks [9, 10,20] .

The reason for this longer stay of patients is mainly due to complexity of concurrent illness and need to improve his general and immune status.

From our study we learnt that duration of surgery also influence the incidence of infection. In our study the infection rates for duration of surgery 1, 2, >3 hours are respectively. This shows a increasing trend in infection rate as duration of surgery prolongs [4, 10,22] . In the 10 years of the Foothill hospital study by Cruse and foord (1980), cases lasting less than 1 hour had an infection rate of 3%, roughly doubling with every hour of the procedure [10].

As the duration of surgery increases , there is a increased exposure of bacteria from exogenous sources and contamination of wound. This risk further related to the length of incision and local tissue damage.

Bacteriological study revealed that that out of 33 infected cases 19 cases showed evidence of growth. Among which Klebseilla was most commonly isolated contributing 24.2%, followed by E.coli 18.18%, Pseudomonas 6.06, Staphylococcus 6.06 and Actinobacter 3.03% .In about 14 cases , pus culture yielded no growth. Giacometti et al, in their study of 676 surgery patients with signs and symptoms indicative of wound infection, reported 614 patients (90.8%) to be culture positive for bacteria [35].

Anvikar et al, reported a similar pattern in their study of 200 cases. Klebsiella Species was isolated in 100 cases (28.8%) [5]

Earlier days , the most feared organisms isolated were streptococci, staphylococci. Now the pattern has changed to more of Kleibseilla . The recent trend is shifting from Gram positive to Gram negative organism which is commonly isolated .

Other criteria considered with regards to surgical site infection was use of prophylactic antibiotics before surgery. Among 249 cases, 124 cases were given prophylactic antibiotic, out of which only 2 were infected (1.6%) and 125 were not given , 6 were infected (4.8%). This shows that better preoperative preparation can effectively reduce the incidence of infection [5,23].

Regarding antibiotic sensitivity, Klebseilla isolates were responded well to ciprofloxacin, cefotaxime, cefaperazone sulbactam ,amikacin and gentamicin. E.coli responded to ampillicin, amikacin, cefotaxime, ceftriaxone. Pseudomonas infection was treated with ceftriaxone, cefaperazone sulbactam. Staphylococcus was treated with ciprofloxacin, ampillicin and with more specific antibiotics like vancomycin, teicoplanin. Actinobacter was isolated in case and was treated with cefaperazone sulbactam.

Similar antibiotic sensivity results were obtained in study by Anvikar et al, which reveals that we require specific antibiotics than commonly used to treat surgical site infection.

Bacteriological Surveillance

In our study among 33 cases of wound infection gram negative organisms were most often responsible for wound infection than gram positive organisms.

Klebseilla species were most frequently isolated. Next in order are *E.coli*, *Pseudomonas* and then comes *Staphylococcus* and *acinetobacter* [4].

Changing Flora

Since 1975 significant change in type of infection noted.

- Rised occurence of gram -ve infection.
- Added and secondary infection occur during antibiotic therapy

- Fungal and viral infections occurring more so in immunocompromised individuals.
- Entering of several antibiotic resistant organisms due to frequent use of antibiotics [6].
- More incidence of infection by organisms previously recognised having little or no virulence.
- Growing awareness of anaerobic infection and mixed/synergistic infection.

Complications

Without a note on complications no study is complete.

All the 33 cases had wound gaping (superficial or deep). Out of 33 cases 25% healed by secondary intention, other patients needed resuturing.

Burst abdomen resulted in two cases, one case of advanced carcinoma of stomach for which palliative anterior gastrojejunostmy with jejunojejunostomy was done. Another case of obstructive jaundice *–Periampullary carcinoma* where triple anastomosis was attempted.

Enterocutaneous fistula developed in 1cases. A case of sigmoid volvulus where primary resection and anastomosis attempted.

Incisional hernia developed in 3 patients one in the Mc Burney's incision through which an appendicular abscess was drained , another in the upper

midline scar where a gastric perforation closure done, another case of enteric ileal perforation brought in a state of advanced peritonitis and shock opened through mid midline incision.

Death occur in two patient 1 case of obstructive jaundice and 1 case of periampullary carcinoma.

This topic is chosen for study since surgical site infection (SSI's) are the second most common cause of nosocomial infections. Upto 2-5% of patients undergoing clean extra abdominal operations and upto 20% undergoing intra abdominal operations will develop surgical site infection. Patients who develop surgical site infection are upto 60% more likely to spend time in an ICU, five times more likely to be readmitted to the treatment and twice the times of more chance of to mortality than are patients without surgical site wound infection. Health care costs are substantionally increased for patients who develop SSI's (Dale W.Bratler Peter M.Houck *et al*.,2004)

CONCLUSION

Incidence of surgical site infection in our study is 7.2%. Scoring system based on various risk factors (7 major criteria & 4 minor criteria) carried out in our study and it is found that the incidence of site surgical site infection is high when score is more. This type scoring system is also useful for assessing the severity of surgical site wound infection.

In our study among 33 infected cases, *Klebseilla* species were most commonly isolated. Next in order are *E.coli*, , *Pseudomonas* and then comes *Staphylococcus* and *acinetobacter*. Change in bacterial gram positive organisms to gram negative organisms due to frequent use of antibiotics.

Our study many of the bacterial organisms is sensitive to Amikacin, Ciprofloxacin and cefoperazone sulbactum, doxycycline, ampicillin, in descending order of frequency.

Wound gaping, burst abdomen, enterocutaneous fistula, incisional hernia, and death due to sepsis were observed as post operative complication due to wound infection.

The best way to decrease wound infection is by vigorous surveillance and reporting of wound infection rate.

Surgical site infection (SSI) continues to be the most common complication following operative surgical procedures. This surgical site infections are the biological addition of several factors the innoculam of micro

organisms into the wound during the surgical procedure, the unique effectiveness of contaminants , the microenvironment of each wound and the integrity of the patients host immune defense mechanisms.

Several methods is used to achieved to Prevent surgical site infection. The viable innoculam of micro organisms in the wound is decreased by good preoperative preparation of the operative site, good infection-control practice while performing surgery and adherence to principles of preventive antibiotic therapy, modified surgical technique can decrease the risk of hematoma or seroma formation, tissue injury and foreign bodies within the surgical site that increase the risk of infection for a given level of innoculam. Enhanced oxygenation, better core body temperature control and vigorous blood sugar control in the surgical patients are new areas that have potential to even further reduce the rate of surgical site infection.

Although surgical wound infections cannot be totally eradicated a decrease in the number of infection to a low level can have enormous benefits by reducing post operative disease rate and death rate and wastage of hospital resources.

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PROFORMA

A. General Particulars

Name: Age: Sex: IP No:

(or)

Hospital No:

Address :

Date of admission:

Date of surgery:

Date of discharge:

B. Pre-operative status of the patient

1. Preoperative hospitalisation

   Date From: To:

2. **Nutrient status:**

   a. Normal nutrition

   b. Mild nutrition

   c. Moderate nutrition

   d. Severe nutrition

3.Haemoglobin

a. Normal 10-12 gm%

b. Moderate anaemia 8-10%

c. Severe anaemia less than 8 gm%

4. Presence of systemic infection

5. Diabetes

6. Drugs administered Antibiotics

Steroids

7. Investigations performed (Relavant / predisposing)

Noninvasive Invasive

C.Operative Particulars

1. Type of surgery performed
2. Surgeon : experienced surgeon / PG student
3. Duration of surgery
4. Skin preparation and solution used
5. Site of incision
6. Types and number of drains used
7. Condition of the skin
8. Usage of intra operative antibiotics

D. Post-operative assessment

1. Type and frequency of dressings
2. Post- operative antibiotics course and duration
3. Post operative infection (complications)
   a. Uncomplicated and no wound infection
   b. Septicemia
   c. Respiratory tract infection

d. Urinary tract infection

e. Shock

f. Gas gangrene

g. Others

E. Nature of wound infection

a. Stitch abscess

b. Mild infection

c. Moderate infection

d. Severe infection

F. Bacteriology of infected wound

a. Type of bacteria identified

b. Sensitivity to antibiotics

c. Response to antibiotics

d. Outcome of the wound

MASTER CHART

S. no	Name	Age	Sex	Ip.no	Diagnosis	Procedure	Pathogens	Drug sensitivity
1	Subbaiya	60 yr	Male	6260	Duodenal perforation	Emergency laprotomy & perforation closure	Pseudomonas sp	Cefoperazone, Ceftrioxone
2	Rajan	36 yr	Male	7388	Duodenal perforation with thyrotoxicosis	Emergency laprotomy & perforation closure	E.coli	Cephalexin,Ciprofloxacin, Gentamycin, ceftrioxone, ampicillin,cefotaxime.
3	Mariapppan	50 yr	Male	6635	Carcinoma ceacum	Right hemicolectomy	Klebsiella pneumonia	Doxycycline, amikacin, ceftazidime
4	Essakiamma l	65 yr	Female	16466	Duodenal perforation	Emergency laprotomy & perforation closure	No growth	
5	Murugan	54 yr	Male	16682	Advanced carcinoma stomach	Feeding jejunostomy	Pseudomonas sp	Ciprofloxacin, ceftazidime, Ceftrioxone
6	Periyasamy	32 yr	Male	16854	Blunt injury abdomen, left colonic injury	Defunctioning ileostomy	acinetobactor	Cefoperazone sulbactum, Gentamycin, amikacin,
7	Rajamani	55 yr	Male	21036	Appendicular perforation	Emergency open appendicectomy	E.coli	Gentamycin, Ciprofloxacin,ceftrioxone cefotaxime, ceftazidime

8	Anandh	40 yr	Male	27266	Carcinoma right colon	Right hemicolectomy	E.coli	Cefaperazone sulbactam
9	Jai singh	40 yr	Male	28162	Duodenal perforation	Emergency laprotomy & perforation closure	No growth	
10	Mariraj	35yr	Male	33367	Acute on chronic pancreatitis with pseudocyst of pancreas	Gastrocystostomy	No growth	
11	Ananthi	37yr	Female	33698	Cholecystitis	Open cholecystectomy	No growth	
12	Esakkithai	55yr	Female	36945	Sigmoid volvulus	Resection anastomosis with Defunctioning colostomy	No growth	
13	Subramanian	59yr	Male	35347	Obstructive jaundice	Triple bypass	E.coli	Amikacin
14.	Murugesan	55yr	Male	33653	Periampullary Ca	Whipple's procedure	No growth	
15.	Ganasekran	58yr	Male	39564	Duodenal perforation	Emergency laparotomy& perforation closure	Kleibseilla pneumoniae	Gentamycin,Ceftazidime
16.	Mariyappan	33yr	Male	42400	Blunt injury abdomen with mesenteric	Peritoneal lavage and repair	Kleibseilla pneumoniae	Gentamycin

					tear			
17.	Ilayaperumal	50yr	Male	45831	Ileal perforation	Perforation closure with loop ileostomy	Kleibseilla oxytoca	Ciprofloxacin,Gentamycin, cefotaxime,amikacin,septran
18.	Nambi	40yr	Male	45792	Ileal gangrene	Loop ileostomy	Kleibseilla oxytoca	Cefaperazone sulbactam, Amikacin
19.	Ramasamy	60yr	Male	48032	Liver abscess with fecal peritonitis	Perforation closure with ileostomy/COPD	Staphylococcus aureus	Ciprofloxacin,Tetracycline,cefoxitin
20.	Ramakrishnan	65yr	Male	47765	GIST-Stomach	Subtotal Gastrectomy	No growth	
21.	Perumal	63yr	Male	51870	Appendicular perforation	Emergency appendicectomy	No growth	
22.	Somiya devar	65yr	Male	9680	Appendicular perforation	Emergency appendicectomy	No growth	
23.	Chinnaponnu	30yr	Female	19143	Pyoperitoneum	Peritoneal lavage	No growth	
24.	Ganesan	25yr	Male	19635	Appendicular perforation	Emergency appendicectomy	No growth	
25.	Nallaperumal	59yr	Male	32303	Ileal perforation	Perforation closure with loop ileostomy	No growth	
26.	Shanmugathammal	78yr	Female	43825	Intestinal obstruction	Resection anastomosis	Kleibseilla pneumoniae	Cefaperazone sulbactam
27.	Iyyappan	60yr	Male	49622	Perforative peritonitis	Emergency laprotomy & perforation closure	Kleibseilla pneumoniae	Cefaperazone sulbactam, Amikacin,Doxycycline

28.	Mari	55yr	Male	50299	Intestinal obstruction	Resection anastomosis	Staphylococcus aureus	Ciprofloxacin,Vancomycin,Teicoplanin,ampillicin
29.	Muthuraman	35yr	Male	47598	Duodenal perforation	Emergency laparotomy & perforation closure	No growth	
30.	Murugan	38yr	Male	47553	Ca Rectosigmoid	Loop colostomy	E.coli	Amikacin
31.	Velladurai	36yr	Male		Perforation	Emergency laprotomy & perforation closure	No growth	
32.	Durai	38yr	Male		Perforation	Emergency laprotomy & perforation closure	Kleibseilla oxytoca	Doxycycline, Amikacin,Cefotaxime
33.	Ponmalasamy	34yr	Male	47407	Appendicular perforation	Emergency appendicectomy	E.coli	Doxycycline, Amikacin,Imipenam.